AMRAD NEWSLETTER

Amateur Radio Research and Development Corporation March 1982

OUR MARCH 1 MEETING will be a tutorial on internet protocols with focus on the National Bureau of Standards version. Leading the discussion will be Bob Carpenter, W3OTC. This is a particularly "hot" subject at the moment because decisions are needed fairly soon on what type of internet protocol is needed for the packet radio backbone system. This was the main subject at the recent New Jersey meeting attended by several from the Northern Virginia area. See Dave Borden's "Protocol" column in this issue for the minutes of the NJ meeting. As usual, this meeting will be held at the Patrick Henry Branch Library, 101 Maple Ave East, Vienna, VA. Visitors are welcome. Meeting time is 7:30 - 10:00 P.M.

ON APRIL 3&4 NEWINGTON, CT will be the site of a second meeting of the East Coast packeteers. The object of the meeting is to move ahead on network protocol standards. Originally, we were planning to have the meeting on Saturday, April 3 but were informed by some of the NJ group that this was the day of the Flemington, NJ hamfest in which some of the people were involved. So, it looks now that the main meeting will be held on Sunday morning and early afternoon. However, we will probably have some informal meetings late Saturday as well. Check next month's newsletter for details.

OUR APRIL 5 MEETING will take up the subject of packet radio hardware, including the various node controller boards and how to interface them to your terminal and radio equipment. Dave Borden, K8MMO and Terry Fox, WB4JFI will lead the discussions. Again, this meeting will be in the Patrick Henry Library, Vienna, VA.

Also at the April 5 meeting, time will be available for the great 1982 junk box transfusion. Bring along your small pc boards, ICs and other electronic components for exchange. The rule is to limit what you bring to whatever you can carry inside of **one** attache case on which the cover will still close.

THE BALTIMORE HAMBOREE AND COMPUTERFEST will be held on March 28 at the Maryland State Fairgrounds, Timonium, MD. Paul Rinaldo, W4RI will be speaking on Amateur Radio spread spectrum experimentation.

THE TRENTON COMPUTER FESTIVAL will be on April 17-18 at Trenton Stage College, just outside of Trenton, NJ. It will have expanded flea market and commercial exhibit areas as well as other activities. AMRAD will conduct one of the sessins devoted to packet radio. Steve Robinson, W2FPY will be handling a packet tutorial. This looks like another opportunity for some of the East Coast packeteers to get together. Admission to TCF-82 is $5 for the two days ($3 for students). The Saturday night banquet is $10. Flea market spots are $10 per day. For more information, contact: Dr. Allen Katz, K2UYH, Trenton State College, Hillwood Lakes CN550, Trenton, NJ 08625, 609-771-2487.

THE DAYTON HAMVENTION will be April 23-25 this year. There will be two packet sessions -- one as part of a group of tutorials, the other (presently scheduled for 3:30 on Saturday) as a packet forum. Doug Lockhart, VE7APU and Paul Rinaldo, W4RI will lead the forum. There is also to be a spread spectrum tutorial on the program. AMRAD may or may not be involved in that session, but we did get a chance to go over the topical outline. Two of the Dayton spread spectrum devotees recently attended one of Robert Dixon's courses on the subject at George Washington University.

A PC BOARD LAYOUT PROGRAM and documentation program ($729 each) are available from Dasoft Design Systems Inc, according to an item in <u>EDN</u> magazine for February 3, 1982.

IF YOU'RE ABOUT TO MOVE please don't forget to send us your change of address so you won't miss copies of the newsletter. To keep costs down, we mail the newsletter to U.S. members using Third Class which, unfortunately, is not forwarded.

THE DEAF AND THE TTY

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DEAFNET UNPLUGGED!

As this column is being written, DEAFNET is on its last legs. Word has reached us that pending disposition of surplus government items, DEAFNET has been sustained on a day-to-day basis.

Was DEAFNET a mistake to begin with? To my knowledge, there are four different kinds of electronic message systems. There could be more, but I have been exposed to only four kinds which are the basis of my views. The first on is GTE Telemail. I am subscriber to the nationwide (only 50-60 deaf users) GTE Telemail, hosted by Deaf Communications Institute of Framingham, MA. The second one is The Source (and also MICRONET), which needs no introduction in this column. The third one is the microcomputer message system, such as the AMRAD CBBS, HEX, Washington Apple Pie, and Family History Forum. The fourth one is DEAFNET itself, possibly in a category of its own.

I have used DEAFNET so much more frequently than any other message system that it has become second nature with me. What DEAFNET has is what other message systems lack. Thus, I am afraid that DEAFNET features being a luxury, disenfranchised users will then switch to other systems, perhaps HEX, and suddenly express dismay at the lack of frills found existing.

In a nutshell, with DEAFNET, one can:

1) use Baudot TDDs--only HEX also has this capability;
2) chat with on-line users--The Source has it, but DEAFNET users are known to each other, while on The Source, users are identified only by their code names;
3) take their sweet little time in typing messages, as costs are charged so much per character, rather than in units of connect times;
4) log out of one box and then log into another without hanging up and redialing --the other systems that I know lack this capability;
5) access through one of 24 separate phone lines--the micros can only only one or two lines;
6) retrieve messages very fast--HEX retrieval is slower;
7) access the bulletin board with ease with as few commands as possible--contrast it with the encyclopedic bulletin board manual of The Source, or even with a multitude of one-letter commands of the micros;
8) access with a feeling of security--it is much easier for an abuser to crash the micros than to bring DEAFNET down.

Perhaps DEAFNET is the ultimate in communications, a composite of the outstanding features of other types of electronic message systems. And perhaps its staggering expenses is what curtailed DEAFNET's existence. Thoughts of possible consortium of organizations of the deaf to underwrite DEAFNET as a self-supporting enterprise received cold water when monthly costs were revealed to be $2,500. If 500 users paid $5 apiece per month, the the break-even point would be achieved. But in DEAFNET's heyday, it had a maximum of only 250-300 users, most paying only $3-$4 per month.

At any rate, in 1968, man landed on the moon. Then only one more moon trip was made. An then there were no more. Prohibitive costs have aborted planned future trips despite tremendous strides of technology occurring between 1968 and 1982. Has DEAFNET suffered the same fate? □

"ARRL PROGRAM FOR THE DISABLED" is a new booklet avaiable from ARRL Hq., 225 Main St., Newington, CT 06111. To obtain a copy, send a 9 x 12-inch s.a.s.e. with 88 cents postage). The booklet lists various services and organizations of interest to the handicapped as well as sources of Amateur Radio material other than in printed form. It is particularly complete with respect to help for the blind but is light on information for the deaf.

Level 2 Protocol Proposal

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Background

Most data networks are built in several levels or layers. The main reason fot this layering, I am convinced, is to protect the programmer's sanity. Like any major programming effort, if one looks at the overall task, it could become overwhelming. However, if the task is broken up into smaller sub-tasks, each sub-task becomes easier to work out, and the overall task is done sooner.

The major data networks in existence use this approach. The National Bureau of Standards protocols, for example, call for seven distinct layers. They are:

7. Application layer (Highest Level)
6. Presentation layer
5. Session layer
4. Transport layer
3. Internet layer
2. Data Link layer
1. Physical layer (Lowest Level)

The existence of these layers does not mean that the whole network must must have all seven layers. Usually a host processor will have all seven layers within it, while intermediate nodes such as gateways between networks and nodes within the network backbone will only implement up to level 3 or 4.

The lowest level, the Physical Layer, normally consists of an RS-232 interconnection, and/or modems. This level is handled differently by each computer or terminal. There doesn't seem to be a problem at this level. On to level 2.

Present Data Link Implementations

You have probably heard many of the buzzwords describing this level. There's HDLC, SDLC, BISYNC, X.25, and ADCCP just to name a few. Believe it or not, these letters do actually mean something.

HDLC stands for High Level Data Link Control. It is an ISO standard (ISO 3309-1976) consisting of only four pages, two of which have to do with calculating the Frame Checking Sequence. Fig. 1 shows a typical HDLC packet or frame.

The frame starts with a flag (7E Hex) which is used for synchronizing the sender and receiver of the frames.

Next comes an adress field, usually consisting of eight bits, which identifies the secondary station of a connection. HDLC assumes that the data link is being conducted between a primary (master) station and one or more secondary (slave) stations. The primary station maintains control over the secondary stations it is connected to. This is also called an unbalanced system. Sometimes this primary/secondary approach is preffered, while in other applications a balanced system would work out better. More on this in the future.

The next field in an HDLC frame is the control field, which normally consists of 8 bits. This field is used to pass flags and commands back and forth over the data link. As with the address field, the control field can be extended (by prior agreement) in multiples of 8 bits.

Other than describing how the address and control fields can be reached, the HDLC standard does not define these fields.

After the control field comes the information field. This field is of variable length, including no information at all if a supervisory frame has been sent (the information is in the control field).

Next comes the Frame Checking Sequence (FCS). The FCS is a 16 bit field calculated on the overall frame (excluding flags) that is used to maintain frame integrity. If a received FCS doesn't match the calculated FCS on a received frame, the chances are good that the received frame is bad, and should be re-sent.

The last field in an HDLC frame is another flag. If another frame is to be sent immediately, this flag could also be the opening flag of the next frame.

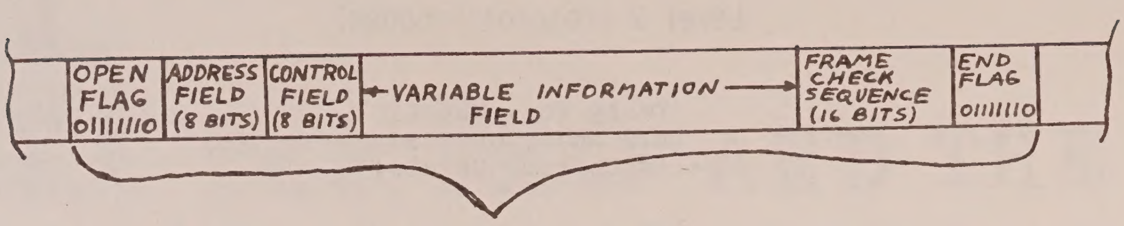
The SDLC (Synchronous Data Link Control) and ADCCP (Advanced Data Communication Control Procedures) standards continue where HDLC leaves off. They describe how the control field is to be used for example, and expand on a balanced (all primary) versus an unbalanced (primary/secondary) system.

What Are We Using Now?

What we appear to be running on the air at the moment is a subset of SDLC/ADCCP.

In the address field, we are running a single 8-bit value assigned to each station in the local area by the local packet guru. More on this addressing later.

In the control field we are implementing some of ADCCP, but not all we probably should. We can request and



TYPICAL HDLC FRAME

FIGURE 1.

acknowledge connects and disconnects, send supervisory-only frames, and send information frames (both normal and unsequenced). At this time we are using an implied rejection of bad frames only. This is when a packet is sent, the transmitting node starts a timeout timer. If an acknowledgement is not received before the timer times out, the sending station assumes the frame was not received properly, and sends it again. If several frames were sent at once, they must all be re-sent. ADCCP allows the receiving node to reject frames (selectively, or all at once) by sending a reject control frame. This is one example of the expanded capability of ADCCP's control field.

The rest of the fields we are using follow standad HDLC.

Present Address Field Usage

At this time we are using a single 8-bit address field. This allows a theoretical maximum of 256 users per local network. Of these, addresses 00 and FF Hex are reserved for no operation and all parties addressed respectively. Bit 7 has been reserved to indicate the station wants to be repeated thru a digital repeater. Bit 6 has been set aside to indicate this packet has been repeated. This is needed so that a station that might be close enough to copy both the original packet and the repeated packet won't display both.

The above restrictions mean the maximum number of stations allowed on a local node would be 62. While we aren't close to that limit at the present time, it is my opinion that once packet radio takes off, this could become a big problem, especially in the larger cities.

Another disadvantage of this system is that if a station moves to another location, either temporarily or permanently, there is a good possibility of a conflict arising with someone else with the same address.

Dynamic Allocation of Addresses

One suggested alternative to the present system is to have the local network controller dynamically assign addresses as individual stations log on. From then on, the network controller will reserve that address for the assigned station (using look-up tables) until he signs off, or he is dropped after not responding to a query initiated by a timeout after not hearing from him. As long as there are fewer than the 62 maximum stations per local network controller, this should work ok. However, a problem crops up when two stations decide to work **direct** -- not through the network. If they were assigned addresses while on a network, those addresses will stay assigned until the above mentioned timeout. The network controller may then reassign those addresses to new check-ins. If one of the simplex stations then returns to the network using his old address, a conflict immediately develops, and the thing must be worked out.

If both stations start out on a direct channel, one of them must decide what addresses to use before communications can begin. Then, if either of them go to a network, the above problem again shows up.

A problem that shows up with both the presently used system, and the dynamically assigned address proposal is that of a station location within two or more local network rf fields. Fig. 2 illustrates this problem. There are 2 local networks, controlled by network controller 1, and network controller 2. Station A has been given address 01 by controller 1, and is "connected" to station B (address 02). At the same time, station C comes on network 2, and is assigned address 01 by controller 2. He then connects to station D, who becomes address 02 on network 2. As soon as station D transmits using address 02, nertwork controller 1 thinks it came from its station 02 (B), and network 1 soon becomes blown away. Also, keep in mind a "local" network could be a city-wide network, or a nation-wide hf network, or a satellite network, so this could become a big problem.

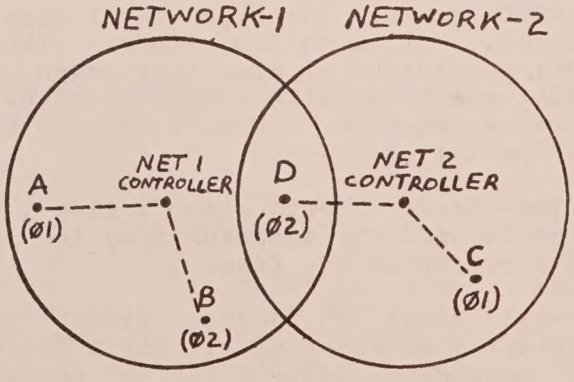


FIGURE 2.

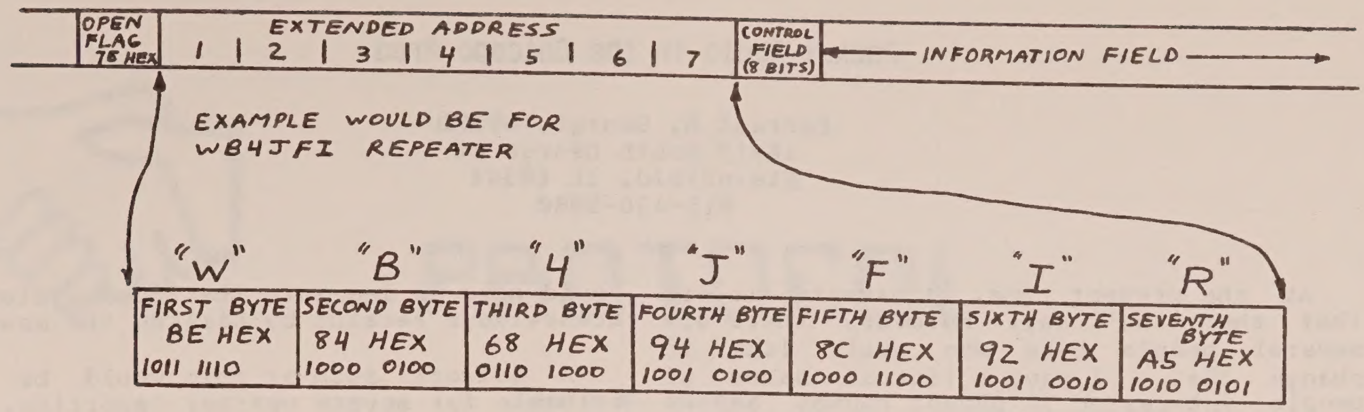


FIGURE 3.

Extended Address Proposal

Obviously, I wouldn't be knocking these other systems unless I had an alternative of my own. As was mentioned before, HDLC allows for the extension of the address and control fields. To extend the address field, bit Ø (LSB) is reset to a zero on all but the last byte of the extended address, which has bit Ø set.

My proposal is to take advantage of this extending capability, and extend the address to seven bytes. The first six bytes would have the sending stations call sign in it, rotated one bit left to allow for the HDLC extended address bit in bit Ø. The seventh byte is reserved for qualifiers such as "R" for a repeater. This seventh byte, if there, would be forced upper case so it only used six bits. The seventh bit is is set aside to indicate this packet has been repeated (the same as bit 6 in the present system). The eighth bit (bit Ø) is set to indicate the end of the address field (see Fig. 3).

The advantages of this system are as follows:

1. Every station has a fixed, God-given (FCC), unique address.
2. Relocating to a new location no longer creates a problem.
3. Allows for more than 62 users.
4. No local packet guru needed to assign network addresses.
5. Direct or network operation requires no changes.
6. The amateur call is in each sent packet, showing exactly what station it came from.

Some of the disadvantages to this system are:

1. Six extra bytes overhead needed.
2. Since the 8273 only checks the first byte of an address, the processor must now check the addresses of all packets.
3. The 8273 must run in the unbuffered mode, increasing processor overhead again.

In my opinion, this system's advantages far outweigh its disadvantages. Every Amateur Radio station is given its own unique call by the FCC. Use of these call signs as addresses will assure that there will be no conflicts from other networks, and a user could even jump around between networks without creating problems. Also, stations could operate directly with another station, via repeaters, with hosts, or virtually any other arrangements without a major hassle.

Because each packet would have the sending Amateur's call sign in it, maybe the FCC might consider dropping or altering its ten-minute i-d requirements. This could save quite a bit of time when everyone on a network is identifying at different times.

The disadvantages to using this system all seem to add up to increased overhead for the controlling processor. Because there are seven bytes to send in the address field, and the 8273 (Intel HDLC processor chip) handles only address comparisons of one-byte addresses, the main processor must do the rest of the address comparison, eating up valuable CPU time. The selective receive mode of the 8273 can still be used, and it can also still look for up to two separate addresses, allowing the station to look for the intended sender, or an all-station alert (address FF Hex). The 8273 could at least weed out calls with the first byte wrong, such as a WB4JFI received while looking for K8MMO. The subroutine needed to compare the rest of the address would drop out as soon as a wrong byte was detected, saving more processor time.

The 8273 has only a one byte internal buffer for the address field, so an extended address requires the 8273 to run in the unbuffered mode. This also increases the amount of processor overhead, because each frame must now have the address and control fields appended to the beginning before sending it out.

I would appreciate any comments pro or con on this idea, as it still a proposal, and not yet cast in stone. □

Packet Radio in the Chicago Area

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At the present time, I have to report that there isn't any, however, there are several people here who would like to change that. I have a list of names of people interested in packet radio, and we hope to hold an organizational meeting soon. I would like to hear from anyone who would like to be included.

I have written a program for the H8/H89 called TBYE, to implement RTTY access to a CP/M bulletin board via a 2-meter fm simplex channel. The next step will be to get several of these up and then link them together via a packet radio link. This approach will provide network access to any standard amateur RTTY station. Messages between local users will remain on the local bulletin board. Messages to users not on the local system will be automatically routed to the appropriate destination system, and the next time that the person logs in, he will be informed that a message is waiting for him. If he is currently connected, a virtual channel could be opened, and the two users could communicate essentially in "real time."

Another idea would have the local bulletin board system deliver the message by activating the addressee's selcal autostart. A "smart" system might even acknowledge the message, but most users would have to log into the local system and acknowledge receipt by killing the message.

A network such as this would be very valuable for severe weather reporting. An observer could automatically alert a selected list of stations in the path of the storm by inputting the proper message. The packet network would distribute this message to the appropriate local systems, which would then transmit it to individual stations according to a prearranged list. If desired, the system could be programmed to send out pager tones to alert key people to go read their TTY machine.

These ideas only scratch the surface of some of the things that could be done. The commercial people are getting very interested in electronic mail, data networking, and many other "office-of-the-future" areas. In spite of this I believe that hams can continue in the tradition of developing new communication techniques and lead the way in the development of new ways of personal communications.

If you wish further information, please contact me at the following address: Forrest R. George, W9SKD, 16219 South George Ct, Plainfield, IL 60544, 815-436-5980.

□

AMRAD MEMBERS ARE ENCOURAGED to look over the articles in the past newsletters by Jerry Dijak, W9JD on the subject of error correction on hf. He invested the time and effort in organizing and documenting his project so that the rest of us could clearly see what he did. The AMRAD Newsletter is an excellent vehicle for publishing on-going state-of-the-art development of this type. Terry Fox's think piece on link-level addressing is an example of using the newsletter as a sounding board for new ideas. We'll also publish alternative views. Also, this month, we welcome a regular column by the Tucson Amateur Packet Radio group. We would like to see regular columns from other areas such as the Northeast and West coasts.

COMPUTER PREPARATION OF THE NEWSLETTER is now into full swing. An S-100, CP/M and WordStar are used along with a Diablo HyType I printer to produce a single column of text. The columns are then cut and pasted to an 11-by 17-inch sheet for photo-offset printing. To cut down on keyboarding, some material is accepted via the phone lines using MODEM7 software. Any contributors wishing to do this should first call the editor, Paul Rinaldo, W4RI on 703-734-0878 (voice) to arrange for the data transfer on a data line. To keep the editing to a minimum, please arrange the text in a single, continuous column (no page breaks) 43 characters wide. Indent paragraphs 3 spaces, subparagraphs 3 more, etc. Use the standard ARRL abbreviations found on page 67 of the December 1981 issue of QST. Any artwork should be camera ready, that is black ink on white paper - just the way you'd like to see it in print. Actually, it will appear about 77% of that size most of the time. If space is critical or if the artwork is oversized, it could be reduced as much as 50%. Black and white photographs can also be printed if essential to the article. Please send only black and white positives on glossy paper. We still will welcome articles and columns sent in on paper. If you're thinking about an article, start writing. It'll go easier than you think once you have the first few lines written.

PROTOCOL

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News

On 08 February 1982, Howard Nurse, W6LLO and Ed Kalin, K1RT successfully exchanged HDLC packets on 14.075 MHz. The QSO was short and experimental, but packets were exchanged in both directions. This could be the first successfull HDLC packet HF QSO.

Meeting

This month, thanks to some excellent notes prepared by J. Gordon Beattie Jr., WB2CAM, we have minutes of the East Coast Packet Radio Standards Meeting held in Flemington, NJ on 23 January 1982. This was basically an exchange of ideas on behalf of the New Jersey gang and the AMRAD packet radio troops. It was a very worthwhile session.

The meeting commenced at about 10:30 with some opening comments by Paul Rinaldo, W4RI. At this time, an agenda, which he had prepared, was distributed.

Dave Borden, K8MMO gave a presentation on the fundamentals of packet radio. Bit-synchronous protocols were described, and the devices designed to implement them discussed. It was noted that the Intel 8273 and the Western Digital 1933 were the only two established devices which allowed for the derivation of the clock from the NRZI-encoded data. The legality of bit-stuffing and the reaction of the FCC to what some people consider gray areas were included. Paul, W4RI, pointed out that the FCC believes that they authorized packet radio and HDLC with the regulations they provided. They view bit-stuffing and NRZI encoding as means to enhance communications and not as an attempt to encode or encipher the text. The conclusion was that the FCC is open to petitions regarding cw identification, and to requests for authorization to use modulation techniques varying from the present bit equals baud regulations. The FCC also feels, it was pointed out, that a single-frequency packet repeater is a true repeater of the time type rather than the traditional frequency type. As such, these machines must be placed in the repeater sub-bands. The question was raised by the audience if a mailbox station on the lowbands is a repeater. The difference appears to be only the time delay on a mailbox is longer. Thoughts on this point should be directed to WB2CAM.

Terry Fox, WB4JFI, presented comments on the hardware and software limitations of the Vancouver Terminal Node Controller (TNC) boards and described his new S-100 HDLC board designed for station node service. He pointed out that the Vancouver boards have a maximum link capacity of 19.2 kilobits. More horsepower is in order for station switching nodes.

Several presentations followed in fairly rapid succession by representatives of other groups.

Gwen Reedy, W1BEL, of the south Jersey group, reported that several Vancouver boards had been completed and were in the testing phase.

Paul Newland, AD7I, of the Holmdel group, mentioned that he had Bell Standard 202 compatible modem and TNC designs which were in the process of release from his place of business. He revealed that the TNC was Z80 microprocessor based and used the Zilog SIO. This afforded the user two flexible serial interfaces in one package. Some software has been written and the boards do talk to each other. Paul pointed out that the Zilog SIO does not have a clock recovery circuit and therefore requires external circuitry to perform the NRZI-encoding. State machine technology was introduced as the answer to providing the clock recovery circuit essentially using a programmable read only memory and a flip-flop.

Steve Robinson, W2FPY, of the Ramapo Mountain Amateur Radio Club in Oakland, NJ, described the local progress to date. This included a few completed Vancouver boards, a 220-MHz repeater for voice and data, plans for a single-frequency packet repeater and local interest on the verge of explosion.

Bill Ashby, K2TKN, of the Cherryville, NJ Repeater Association, has ordered twenty

five sets of TNC parts for his group to see. He described the extensive repeater configuration established by his group and the Raritan Valley Radio Club. Facilities include a plethora of sites at which the packet network could be located. These are some of the best sites in the state of New Jersey. Bill has also offered some support in the establishment of point-to-point links between systems in the area.

Gordon Beattie, WB2CAM, of the Radio Amateur Telecommunications Society, outlined his group's efforts. A network of dial-up, password-protected, bulletin boards was described. It is in the first stage of implementation. The next step is the establishment of on-the-air interfaces. This should be up within the month. This will yield valuable data on the loading of a Carrier Sense Multiple Access (CSMA) network. It will ultimately be a network resource for all on the air to use. Plans for a unified regional network approach are under development and will require much coordination of groups in the New York-Philadelphia corridor. AMRAD cautions the group that in past years we had bad experience with our dial-up bulletin board with on-the-air 2 meter FM interface. Traffic which is very acceptable on the phone line is considered unacceptable by the FCC for radio. Some screening is required and may be more trouble than it is worth. The San Francisco group, led by Hank Magnuski, KA6M, is doing this now and is having better luck than AMRAD did. Last month (January) stats showed 21 users making 268 calls by packet radio and 133 calls via telephone.

A nice and most welcome lunch was served by our hosts, the Cherryville Repeater Association. Many thanks to Charlie Kosman, WB2NQV for his silent and generous contribution.

After lunch, Howard Lester, W2ODC, the upstate New York coordinator, described the frequency scheme for the inter-city links to be used by various groups in the state. He provided a short history of the group sparked by Den Connors, KD2S, who is living for a few years in Tucson, Arizona.

Paul, W4RI, gave a short presentation on the three elements of "AMNET". They are hf (TERRACON), satellite (AMICON) and vhf (SKIPCON). Each may require some variation in protocol and modes to be used most effectively. Paul described some of his studies into forward-error-correction coding which should prove most useful on hf.

Dave, K8MMO, then presented the introduction to the main portion of the program, the Internet Protocol Standard. Dave began the discussion by describing Terry Fox's idea on the HDLC address field (currently one byte) expansion to include the entire amateur callsign. This solution allows solving the visiting fireman problem and unique identification is provided for each packet transmission in the network. Dave included the KA6M idea of including an extra character (qualifier) to discriminate between different processes at a given station. K8MMO* could be used for the computer host node at K8MMO's packet station, and K8MMO# for the printer and K8MMO(space) for the terminal-to-terminal communications at K8MMO. Terry's idea requires further thought and mainly additional code to be written for the Line Interface Program (LIP).

Terry, WB4JFI, presented the main portion of the AMRAD part of the program by describing the differences between the ARPANET Internet Protocol and the NBS Internet Protocol. He pointed out that AMRAD favors the NBS version. Discussion was held concerning the lack of need for some parts of the Internet header. It was emphasized that local groups can do whatever they desire protocol wise, but when entering the backbone network, adherence to the Internet Protocol will be required. Steve Robinson, W2FPY, made a suggestion that table-driven software be used (essentially dynamic routing) and this seemed to make a lot of sense and evoked a large amount of comment, both pro and con.

AD7I presented an addressing scheme that utilized the address-detection feature of the protocol cguos by using a self-assigned "magic number" which would cause the generation of an interrupt, setting into motion the full i-d-checking algorithm. This number could be sent to the local station node at network logon time. Most of the chips also allow for an "all call" address, and control of the selective receive function. From this it is plausible to work up something for at least the station nodes. Some idea such as this is especailly useful for busy multipoint switching nodes and other stations handling multiple virtual connections. This protocol scheme has been dubbed the Keep It Simple Stupid (KISS) protocol by the Bell Labs gang.

The next meeting was planned for Newington, CT at the ARRL headquarters in April.

Paul, W4RI and Doug Lockhart, VE7APU will be speaking at the Dayton Hamvention concerning packet radio.

Thanks again to J. Gordon Beattie Jr. who wrote most all of his report on our NJ conference. □

WD1933 SYNCHRONOUS DATA LINK CONTROLER chip (alternative HDLC chip to the Intel 8273) specifications are available from Western Digital Corp., 3128 Redhill Ave, Box 218Ø, Newport Beach, CA 92663, 714-557-355Ø. If you're ordering them, you should also ask for a copy of "WD1931/WD1933 Compatibility Application Notes.

Tucson Amateur Packet Radio Activities

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January was a banner month for TAPR. Our hardware and protocol have been developed, and current activities are detailed below. Lyle Johnson, WA7GXD explains the final version of our first terminal node controller (TNC) and in this month's column spotlights the non-volatile RAM chip used for setting terminal parameters. Chuck Green, NØADI explains some of the design criteria and benefits of the TAPR "universal" protocol. And next month's column will include an article on the structure of the FORTH programs used to implement the first local area protocols.

TAPR Hardware Report WA7GXD >

This will be a regular feature of the TAPR column, the purpose of which is to disseminate information on the activities of the TAPR Hardware Group, presently headed by Lyle Johnson, WA7GXD.

The first major project is the TAPR TNC. It is a 6502-based, stand-alone device intended to act as an intelligent interface between a user and the local area network (LAN). By way of introduction, the vital statistics follow:

CPU	-6502
User I/O	-(1) RS-232-C-type serial port (5Ø to 19,2ØØ baud) -(1) TTL-compatible handshaking parallel port
LAN I/O	-Western Digital 1933B-Ø1 HDLC controller, NRZI w/PLL -On-board Bell-202-style 12ØØ-baud modem
ROM	-2 to 3k EPROM in 28-pin JEDEC byte-wide sockets (initial version populated with 12k of 2732 EPROM)
RAM	-2 to 8k static in 28-pin JEDEC byte-wide sockets (initial version populated with 4k of SRAM) (can go to 4Øk when 8k byte-wide parts are available)
Size	Approx 5- by 9-inch pc board
Power Supply	+12 V and +5 V, regulated, on board (power transformer, 5-V chip and capacitor off board)
Special	-On-board 256-bit EEPROM for user interface customizing -On-board calibration of modem to ±5 Hz -Complete self test at power up, including RAM bit test -Hardware watch-dog timer on transmitter PTT line -User custom wire-wrap area provided -Status LEDs provided for modem cal, rcvr level set, xmtr key, cw i-d -Dynamic allocation of memory based on self-test results -On-board FORTH-like language for rapid software changing -Capability for down-loading of software -Bipolar PROM address decoder for mixing of memory chips -RAM/ROM ratio variable due to byte-wide socket design (there are six 28-pin byte-wide sockets on board.) -Boards are wave-soldered with all ICs socketed -Complete documentation
Price	Estimates are as follows: Pc board $25-3Ø Pc board parts $1Ø5 (includes 12k EPROM, 4k SRAM) Cabinet, etc. $35 (Note that some of the pc boards parts will be shifted to the pc board cost as these parts will be wave-soldered onto the board.)

During the next few months this column will highlight some of the unusual and advanced features that make the TAPR TNC the logical choice for local area networks. This month's highlight is the user configuration system hardware.

Three DIP switches are provided to select word length (7 or 8 bits), parity (on/off) and parity sense (odd/even). At power-up, the TNC checks the EEPROM to see if it has been programmed. If not, the DIP switches are read, then the TNC checks the serial and parallel ports for the character

'U' (55 hex). If not found, the baud rate in the serial port is decremented and the process repeated. This continues until 'U' is found. The TNC then activates the sign-on procedure, through the serial or parallel port, as appropriate.

If the EEPROM has been initialzed, the default port configuration will be read. Such things as call sign, baud rate, terminal width (20 to 132 columns), echo/no-echo, BS and DEL handling, control Q/S/U temporary settings (power-on default not altered) or as 'permanent' settings (power-on default updated). It even has a bit to tell the TNC if it should list the default settings at power-on, or not (useful for bulletin-board style users who want everything set up at default and don't like to answer questions). This gives the convenience of default allocation of parameters with the flexibility of user-alteration of those settings. We feel that it is the best of both worlds.

Next month: self-test, calibration and diagnostic features.

Please write and let us know what you think. We want the TAPR TNC to reflect the experience of all Packeteers, and all comments and questions are welcome. Mail all correspondence to the address listed at the beginning of this column (s.a.s.e please, if you want a direct reply). We are also soliciting inputs for major project number two -- a vhf/uhf packet rf board -- now in the preliminary planning stage. < WA7GXD

TAPR Protocol NØADI >

The TAPR protocol development has involved many hours of study of the other protocols and discussions and people in other packet radio groups. Although no protocol can ever satisfy everyone's ideas of what should be included, we have attempted to come up with a good workable protocol which keeps as many options open for future implementation as possible. In all of this, we have attempted to keep the amount of data actually transmitted as low as possible.

The following items are already included or will be included as soon as time permits:

-The basic environment within which the TAPR protocol is implemented is that of a carrier-sensed multiple-access channel. When a station wishes to send a packet, it is free to do so if it cannot detect the carrier of any other station. If collisions occur, a system of random delays is used to increase the possibility of stations successfully sending their packets.

-The protocol is implemented in such a way as to not preclude the future development of more structured environments for times of heavy channel use.

-HDLC protocol structure is used.

-A system of dynamic address assignments is used. A seven-bit number is assigned to stations coming on frequency. This minimizes the amount of data sent for intra-network packets (call signs are not transmitted) and is totally transparent to the user. Not being tied to a specific permanently assigned address allows a user to move from one compatible network to another without conflict.

For inter-network packets, we found it desirable to transmit call signs to identify the origination and destination stations.

-All stations will have the capability of becoming a network control station (NCS) and, if it chooses, acting as a half-duplex repeater. This allows stations total flexibility in going to another frequency and working direct (this is actually a mini-network with one of the stations acting as the NCS). It also provides a maximum reliability of the system.

-Manual and automatic changing of the NCS is provided for. The operator of the NCS can direct that another station become the NCS. (Being NCS does not require any effort on the part of the operator and can be almost transparent to him.) If the NCS should become inoperative, another station will automatically become NCS, and the entire transition will be totally transparent to most users.

-Both direct and/or repeater operation is possible. Direct simplex operation works just fine. A full-duplex repeater can be used to extend range. A half-duplex "digipeater" can be used (any station can act as a digipeater). A half-duplex and full-duplex repeater as well as direct operation could all exist together or in any combination in one network.

-Two or more networks can use the same frequency, and they could have partially overlapping physical domains. Stations can exist in this overlapping area (with some performance degradation). A station that does exist in the overlapping area can act as a link between the networks involved (transparent to the operator of that station).

-Usually, adjoining networks will be on different frequencies. These networks can be linked together in a variety of ways:

-Direct between the network control stations of the two networks (assumes that the two NCSs are within range of each other)

-using a third frequency

-using the frequency of one of the networks

-Between a user station in one network and the NCS in the other network (assumes that the user 'link' station is within range of both NCSs) using the two frequencies of the networks involved.

-Between two user stations - one in each network (assumes that the two user 'link' stations are within range of each other) using a third frequency.

There is no reason why any of the frequencies involved couldn't be in an hf band.

-Although it is not specifically part of this protocol, there is nothing precluding linking to networks using other protocols. This will require a "gateway" translator station to convert from one protocol to another. Other networks and network protocols are already in existence, and it would be nice to eventually link to them.

-When sending packets to a station in another network, the operator can specify the route (from network to network to network...) or can leave packet routing to be done automatically by the NCSs involved.

This protocol does not yet include methods to operate efficiently in environments involving long response delays as might be expected with high-altitude satellites. It also does not include provision for "party-line" links.

The primary limiting factors in implementing this protocol are the amount of software storage available and the amount of programmer time available to fill it. (We have attempted to maximize both of these.) Although there is no shortage of imaginative ways to consume both of these resources, we are always anxious to hear any suggestions that anyone may have.

< NØADI

Our first general meeting is to be held on February 13th and will include introductory tutorials for the hams in Phoenix and Tucson who are new to packet radio. We are currently trying to figure out a way for one of our members to attend the packet radio protocol working session in Newington, CT April 3/4 and will be sending a large delegation to the ARRL Southwestern convention in early June. We are available every Saturday morning at 1700 UT on 21.280 MHz for a packet radio ssb net, and have contacted a number of other packet groups with similar interests in passing information on this net. We will link 15m to 2m in our area, to include many of our hams who can't get on the hf bands.

The month of February is being spent layout out the board, acquiring components, writing software and keeping in touch with other groups. It is expected that March will be spent trying to figure out why our protocol doesn't work exactly the way we planned it.

Stations interested in more information on our group and its systems should contact one of the officers, or meet us locally on the vhf net (147.75/.15, Wednesdays at 8 P.M.) or on the hf net.

THE W9JD FEC ARQ SYSTEM
PHASE I TESTING COMPLETE

Jerome T. Dijak, W9JDO
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This will be the last article in the regular series that has been elaborating on the design of the W9JD FEC ARQ System. I have been running on-the-air tests with WØPHD (Wally) in Minnesota weekly since October. Thanks to Wally's time and patience, we now have a software system with all but one of its functions working properly. It required several major re-writes of portions of the program and many cross-country letters and telephone calls to get to this point. The process would have been considerably more enjoyable had we been lucky enough to get reasonably good radio conditions on 2Ø meters for our test days -- but usually conditions were terrible. I would like to discuss the state of the software and also some general comments on conducting this type of experimentation.

System Status

I promised in one of the early **AMRAD Newsletter** articles that as soon as I got the system to a workable state I would prepare extensive documentation on it. This has now been done. The documentation exists in 2 volumes. Volume 1 is 33 pages long and is written for people who are going to run the system but not try to write or modify it -- also for people who just want to learn more about it.

Volume 2 is 1Ø2 pages long and supplements the general information in Volume 1. It contains the design details necessary for someone who is going to try to adapt the software to run on another type of computer system (now it runs only on Digital Group Z8Ø computers). This volume includes detailed descriptions of each software module and data structure. It also contains 74 pages of the complete assembler source code listing for the entire program.

For people using Digital Group computers, I am also making available the machine code on audio cassette.

The documentation volumes and cassettes are available from me at the following rates: Volume 1, $5; Volume 2, $15; and audio cassette, $3. (NY residents add sales tax.)

I now consider the bulk of my work on the FEC ARQ System complete. I expect that some additional testing and further development will go on. But this will be at a more reasonable (slower) pace not that 95% of the design goals for the project have been realized. For those who try to implement the system on other machines, I also expect to spend a fair amount of time on the telephone and writing letters providing additional assistance in getting the other systems up. As hard as I tried to include everything possible in the documentation, I am sure that there will still be many questions. The complexity of this system, and the difficulty involved in testing it without another handy computer system make this project more of a challenge than most.

I also expect that as we continue to use the system -- and hopefully some other Digital Group people will be on the air fairly soon -- we will find other subtle bugs in the system that will require more time to correct with software patches.

Test Results

There are a few comments that I can make on the results of the ARQ system tests so far. First, we found many many bugs in the original software, and several of these required major revisions to several of the system modules. Second, we can say that even under good conditions data throughput for the ARQ system is slower than an uncoded system (due to the extra bytes required for check symbols and block overhead). This is one of the costs for the ability to verify error-free reception of data with the ARQ system.

A third finding is that under poor conditions, when many block repeats are required, throughput **really** goes down. These substantial delays between data entry at the sending keyboard and reception at the receiving video display were found to make holding a normal conversation rather awkward under poor radio conditions. On the other hand, of course, once you **did** get the message it was correct -- this is another tradeoff.

We found that the system is indeed fairly immune to temporary jamming and fading on the radio channel. These situations usually stop all data flow temporarily, of course. But the system bounces right back afterwards, and data transfer resumes at the point at which it was interrupted. Under conditions of frequent jamming, however, data throughput becomes frustratingly low.

This is a very complicated system, and during these development stages, certain facets of it were often not working properly. On top of this, Wally, WØPHD, did not have detailed documentation on what the system was supposed to be doing (it had not been written yet). This combination of

conditions made for some frustrating QSOs during the debugging phase, especially when band conditions were their usual poor to bad.

General Comments

This was the first time that I had attempted developing any type of Amateur Radio system like this which required the assistance of other stations to run the on-the-air tests. Setting that up was an interesting experience and may be of interest to others anticipating a similar program for some other purpose.

For the initial testing phase just completed, I needed at least one other interested ham with a computer system in the Digital Group newsletter and also in the **AMRAD Newsletter**. Between these two, I got about 10 letters of interest, of which 4 were people with Digital Group computers. I sent out the initial version of the software and some notes of instruction to the "Digital Group 4" and sent letters to the others telling them that I had decided to run initial tests only with the Digital Group people -- because machine-readable cassette tapes could be used to distribute the software.

For various reasons, only one of the 4 respondents (WØPHD) really managed to get his radios properly interfaced to the computer and the software up and running. Initially, this had me worried. But after a very short time it became clear that conducting the tests with just one other station was going to be a full-time job. I was glad not to have to deal with a larger group during this period. The problem was that with almost every QSO, we were finding new problems, and I had to develop fixes for these. Then I had to send these to WØPHD by letter or telephone before the next QSO. It was a major management effort to keep track of which fixes had been sent to Wally and which had not. I also had to send him a new cassette on several occasions, after major revisions. There was considerable money spent on postage and telephone calls on both ends. Trying to keep 2 or 3 other stations up to speed with the changes would have been a major problem. It also would have been largely a duplication of effort. The conclusion is that to run tests like this one needs to find a willing volunteer who can spend several hours a week in skeds running the tests.

I can also say that it is a great inconvenience to try this sort of thing when the stations are separated by 1000 miles. I am sure that testing time could have been cut in half, at least, had I found a suitable test station within toll-free telephone calling range or within driving distance. There were just too many new and complicated features of this system that had to be understood by the other test station. It was hard to do this over the telephone (long distance) or in letters. (We did not have the convenience of being able to chat about these matters on ssb due to the poor radio conditions that we almost always had.)

Strange Computers

There is one other important point. I developed this software system on a rare and no-longer-sold computer system. Therefore, I knew from the outset that no matter how fantastic my finished product might be, it might never see very wide use due to the effort involved to get it implemented on other types of machines. I decided to go ahead anyway; a business operation probably would have either scrapped the idea at the outset or would have bought one of the more popular computer systems on which to do the developing.

□

AMRAD Amateur Radio Research and Development Corporation

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THE PURPOSES OF THE CLUB are to: develop skills and knowledge in radio and electronic technology; advocate design of experimental equipment and techniques; promote basic and applied research; organize forums and technical symposiums; collect and disseminate technical information; and, provide experimental repeaters.

MEETINGS ARE ON 1st MONDAY of each month at 7:30 p.m. at the Patrick Henry Branch Library, 101 Maple Ave E, Vienna, VA. If the 1st Monday is a holiday, an alternate date will be announced in the *AMRAD Newsletter*. Except for the annual meeting in December, meetings are normally reserved for technical talks - not business.

THE WD4IWG/R REPEATER is an open repeater for data communications (including RTTY), voice and experimental modes. It is located at Tyson's Corner, McLean, VA and has excellent coverage. It features a semi-private autopatch available to licensed members. Frequencies are: 147.81 MHz input, 147.21 MHz output. The head of the technical committee is Jeff Brennan, WB4WLW, 7817 Bristow Dr, Annandale, VA 22003, phone 703-354-8541.

THE AMRAD NEWSLETTER is mailed monthly to members and other clubs on an exchange basis. Technical articles, product announcements, news items, and other copy related to amateur radio and computing are welcom. Honorariums at a rate of $10 per printed page ($20 maximum per author per issue) are paid for original material accepted, Classified ads are free to members. Commercial ad inquiries are invited. The editor reserves the right to reject or edit any portions of the copy. Items should be mailed by the 8th of the preceeding month to Paul L. Rinaldo, W4RI, Editor, 1524 Springvale Ave., McLean, VA 22101, 703-356-8918. Full permission for reprinting or quoting items in the newsletter is granted provided that credit is given to both the author and the newsletter. Mailing to U.S. and possessions is by 3rd Class bulk mail. Canadian/Mexican addresses add $2 for postage. Overseas readers add $8 for air mail or $2.30 for surface.

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THE HANDICAPPED EDUCATION EXCHANGE (HEX) is operated by AMRAD for those involved in education and communications for the handicapped. It accepts both 110/300-baud ASCII and deaf TTY callers. on 301-593-7033. The sysop Dick Barth, W3HWN's home phone is 301-681-7372.

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SPECIAL INTEREST GROUPS are formed as needed. Currently we have SIGs on Deaf Telecommunications, Spread Spectrum and Packet Radio. If you are interested in joining or forming a SIG, please contact Bill Pala, WB4NFB, 5829 Parakeet Dr, Burke, VA 22015, 703-323-8345.

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